REMARKS

Claims 1-50 are all the claims presently pending in the application. Claims 1-2, 4-10, 13-18, 20-22, 25-32, 35-39, and 42-50 are amended to more clearly define the invention. Claims 1, 4, 13, 40, and 45-50 are independent.

Applicant notes that, notwithstanding any claim amendments herein or later during prosecution, Applicant's intent is to encompass equivalents of all claim elements.

Applicant gratefully acknowledges that claims 40 and 41 allowed. However, Applicant respectfully submits that all of the claims are allowable.

Applicant gratefully acknowledges that claims 5-7, 9-12, 15-19, 25-29, and 36-39 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. This Amendment amends the independent claims 1, 4, 13, 40, and 45-50 to recite features of allowable claim 6. Applicant respectfully submits that all of claims 1-50 are allowable.

Entry of this §1.116 Amendment is proper. Since the Amendments above narrow the issues for appeal and since such features and their distinctions over the prior art of record were discussed earlier, such amendments do not raise a new issue requiring a further search and/or consideration by the Examiner. As such, entry of this Amendment is believed proper and Applicant earnestly solicits entry. No new matter has been added.

Claims 1-4, 8, 13-14, 20-21, 30-31, 34-35, and 42-50 stand rejected under 35 U.S.C. 103(a) as being unpatentable over the D'Amico, et al. '100 reference, in view of the D'Amico, et al. '593 reference, and further in view of the Gitlits reference and in yet further view of the

Barlett et al. reference. Claims 22-24, and 32-33 stand rejected under 35 U.S.C. 103(a) as being unpatentable over the D'Amico, et al. '100 reference, in view of the D'Amico, et al. '593 reference, and further in view of the Gitlits reference, in yet further view of the Barlett et al. reference and even further in view of and the Janesch, et al. reference.

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

A first exemplary embodiment of the claimed invention, as defined, for example, by independent claim 1, is directed to an automobile communications method for an on-board mobile station across a plurality of radio zones which are consecutively arranged along a road. The method includes providing each of the radio zones with a plurality of M communication frequencies, providing a plurality of N time slots in one period in each of the radio zones, switching between the M communication frequencies within each of the radio zones using a time division scheme such that a different one of the N time slots is allocated for adjacent radio zones for each of the plurality of M communication frequencies by sequentially switching from one to another at least one time within the one period, and switching one of the N time slots allocated to the on-board mobile station to continuously communicate with the on-board mobile station across the plurality of radio zones. The communication between the plurality of radio zones and the on-board mobile station is made using a single one of the M communication frequencies within at least a single radio zone.

A second exemplary embodiment of the claimed invention, as defined, for example, by

independent claim 13, is directed to an automobile communications system that includes an on-board mobile station movable on a road, a plurality of fixed stations including a plurality of radio zones consecutively arranged on the road. Each of the plurality of fixed stations are communicable with the on-board mobile station using a plurality of M communication frequencies. The system further includes a control station that provides a plurality of N time slots in one period in each of the radio zones, controls the plurality of fixed stations performing continuous communication with the on-board mobile station by switching the N time slots in adjoining radio zones with the on-board mobile station using one of the plurality of M communication frequencies in adjoining radio zones, switches one of the N time slots allocated to the on-board mobile station in accordance with the switching in the plurality of fixed stations and by switching between the plurality of M communication frequencies in each of the plurality of radio zones using a time division scheme such that adjoining fixed stations communicate with a plurality of on-board mobile stations using different frequencies of the plurality of M communications frequency at any given time, and sequentially switches the plurality of M communication frequencies from one to another at a timing of every N/M time slots. The communication between the plurality of fixed stations and the on-board mobile station is made using a single frequency.

As explained by the present specification, conventional communication systems use a Time Division Multiple Access (TDMA) communication protocol in which different time slots are used at the same frequency. These TDMA systems enable a wide frequency range to be used. However, it is necessary to increase transmission power by an amount which corresponds to the

increase in noise to obtain a desired carrier to noise ratio. Additionally, various distortions deteriorate performance. Further, wide-band devices are needed.

By contrast, the present invention provides a novel system having advantages of both Frequency Division Multiple Access (FDMA) and TDMA systems by arranging a plurality of M frequencies in each radio zone and switching these M frequencies in a time division mode within each radio zone and also by switching one of N time slots for each frequency between adjoining radio zones so that individual mobile stations do not have to switch frequencies within a single radio zone.

Rather, each mobile station can communicate continuously using the same frequency within a single radio zone across the plurality of radio zones merely by switching the time slot. In other words, continuous communication is allowed at the same frequency for a mobile station within a single radio zone and the frequency range of each of a plurality of frequencies is substantially equivalent to that of an existing FDMA system.

Additionally, the present invention has a further advantage in that interference between adjoining zones can be avoided. Each zone communicates using a plurality of M frequencies and switches between these plurality of M frequencies in time division manner which is coordinated with adjoining radio zones so that adjoining radio zones do not communicate simultaneously using the same frequency.

In this case, as long as the same frequency is not selected at the same time between adjoining zones, then time slot positions used in adjoining zones are arbitrarily selected. In other words, it is not necessary to select different time slots between adjoining zones. On the other

hand, when a communication frequency is switched, if the same frequency can be selected at the same time between adjoining zones, then different time slots are allocated between adjoining zones.

The present invention provides the above objects and advantages by providing a system and method that provides a plurality of N time slots in one period in each of the radio zones and sequentially switches the plurality of M communication frequencies from one to another at least one time within the one period (independent claim 1) or that provides a plurality of N time slots in one period in each of the radio zones and sequentially switches the plurality of M communication frequencies from one to another at a timing of every N/M time slots (independent claims 4, 13, 40, and 45-50).

For example, as shown in Figure 2 of the present specification, "A" period is provided with N = 12 time slots and M = 2 frequencies. The M = 2 frequencies are switched every N/M = 6 time slots in each radio zone. In particular, in the odd zone, the first frequency ft1/fr1 is used for the first six time slots and the roadside transceiver is switched to the second frequency ft2/fr2 for the second six time slots, et. seq.

Similarly, in the even zone, the second frequency ft2/fr2 is used for the first six time slots and the roadside transceiver is switched to the first frequency ft1/fr1 for the second six time slots. In this manner, continuous communication is provided for the vehicle side transceiver without having to switch frequencies within the vehicle side transceiver while within the same radio zone.

II. THE PRIOR ART REJECTIONS

A. The D'Amico et al. '100 reference in view of the D'Amico et al. '593 reference and in further view of the Gitlits reference and in yet further view of the Barlett et al. reference

Regarding the rejection of claims 1-4, 8, 13-14, 20-21, 30-31, 34-35, and 42-50, the Examiner alleges that the D'Amico et al. '593 reference would have been combined with D'Amico et al. '100 reference and further that the Gitlits reference would have been combined with the combination of the D'Amico et al. '593 reference and the D'Amico et al. '100 reference and goes even further to allege that the Barlett et al. reference would have been combined with the combination of the D'Amico et al. '593 reference, the D'Amico et al. '100 reference and the Gitlits reference to form the claimed invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, the references are directed to completely different matters and problems.

As explained previously in the Amendment that was filed on January 26, 2004, one of ordinary skill in the art who was concerned with the problem of the substantial infrastructure investment and complexity that is required when each cell is required to measure and report signal strength to determine whether to hand off a call between cells as the two D'Amico et al. references are concerned with solving would not have referred to the Gitlits reference because the Gitlits reference is directed to the completely different and unrelated problem of a limited

number of frequencies being available in a cluster of cells for performing frequency hopping.

Indeed, neither of the D'Amico et al. references teaches or suggests anything at all related to frequency hopping.

In stark contrast to the D'Amico et al. references and the Gitlits reference, the Barlett et al. reference is directed to the problem of diversity combining of GSM cellular radio signals without incurring the cost of additional/duplicate circuitry (col. 1, lines 28-35).

One of ordinary skill in the art who was concerned with the problem of the substantial infrastructure investment and complexity that is required when each cell is required to measure and report signal strength to determine whether to hand off a call between cells as the two D'Amico et al. references are concerned with solving or who was concerned with the problem of a limited number of frequencies being available in a cluster of cells for performing frequency hopping as the Gitlits reference is concerned with solving, would not have referred to the Barlett et al. reference because the Barlett et al. reference is concerned with the completely different and unrelated problem of diversity combining of GSM cellular radio signals without incurring the cost of additional/duplicate circuitry.

The Examiner admits that the "combination of D'Amico (US 5,127,100) and D'Amico (US 5,159,593) and Gitlits does not specifically disclose communication between the plurality of radio zones and the on-board mobile station is made using a single frequency within at least a single radio zone." (Emphasis added).

However, the Examiner alleges that the Barlett et al. reference remedies this deficiency.

In particular, the Examiner alleges that the Barlett et al. reference discloses

communication between the plurality of radio zones and the on-board mobile station is made using a single frequency within at least a single radio zone and that "it would have been obvious to one of ordinary skills (sic) in the art at the time of the invention was made to provide the above teaching of Barlett (sic) in the system of D'Amico et al. (US 5,127,100), D'Amico et al. (US 5,159,593) and Gitlits so that the mobile station can handover without a change of frequency (see Barlett, column 4, lines 12-16).

Applicant respectfully submits that one of ordinary skill in the art would not have been motivated to modify the combination of the D'Amico et al. references and the Gitlits reference as alleged by the Examiner.

First, the Examiner appears to be confused about the claim language recited by the independent claims. For example, independent claim 1 recites that "communication between the plurality of radio zones and the on-board mobile station is made using a single frequency within at least a single radio zone." (Emphasis added).

In other words, the communication channel between the on-board mobile station and each radio zone uses a single frequency and, therefore, the communication channel between the on-board mobile station and each radio zone does not switch frequencies as long as the on-board mobile station is communicating with each particular radio zone.

This feature does not preclude the on-board mobile station from switching frequencies as the on-board mobile station moves from one radio zone to an adjacent radio zone. Rather, this feature requires that the same (single) frequency be maintained as long as the on-board mobile station is communicating with the same (single) radio zone.

As explained above, this feature is important to prevent forcing the on-board mobile station from frequently switching frequencies.

Second, this feature stands in stark contrast to the teachings of the Gitlits reference that the Examiner relies upon for a disclosure of switching the plurality of communications frequencies within each of the radio zones in a time division scheme. The Applicant does not contradict that statement.

Rather, the Applicant agrees that the Gitlits reference discloses a switching the frequencies within a radio zone in a time division scheme.

However, not only does the Gitlits reference disclose switching the frequencies of the radio zone in a time division scheme, in stark contrast to the present invention, the Gitlits reference requires that the mobile station also switch frequencies in a time division scheme even while the mobile station maintains communication with the same radio zone.

In particular, the Examiner cites col. 1, lines 47-59 of the Gitlits reference. This portion of the Gitlits reference explains the concept of frequency hopping which is used to reduce the effects of frequency dependent phenomena. As very clearly explained by the Gitlits reference, frequency hopping relies upon "periodically switching between frequencies during transmission of a particular signal." (Emphasis added). In other words, each communication channel between any single radio zone and a mobile station is required to periodically switch frequencies.

This concept of frequency hopping is very clearly illustrated by Figures 4A - 5C of the Gitlits reference. In particular, examining Figure 4A of the Gitlits reference very clearly illustrates that communication channel 1 between a particular mobile station and a single radio

zone (cell1) is required to switch frequencies from f1 to f2 to f3 to f1, et seq. Therefore, this frequency hopping requires the mobile station that is using channel 1 to switch frequencies even while communicating with a single radio zone (cell).

Third, contrary to the Examiner's allegations, the frequency hopping that is described at col. 1, lines 47-59 has no effect upon co-channel interference that the Examiner alleges is the motivation to provide frequency hopping. Rather, the Gitlits reference very clearly explains that frequency hopping is useful for reducing the effects of frequency dependent phenomena such as varying propagation conditions for different frequencies (col. 1, lines 47-59).

The Examiner appears to be confusing the frequency hopping that is described at col. 1, lines 47-59 in the Gitlits reference which does not reduce co-channel interference with the arrangement of a cellular network "into clusters of adjoining cells, such that the cells in a particular cluster each transmit on different frequencies" (col. 1, lines 34-36) "[i]n order to alleviate the problem of co-channel interference." (Col. 1, lines 33-34).

Therefore, contrary to the Examiner's allegation, one of ordinary skill in the art would not have been motivated to modify the combination of the D'Amico et al. references to include the frequency hopping scheme that is described at col. 1, lines 47-59 of the Gitlits reference "in order to reduce co-channel interference" because the Gitlits reference does not teach or suggest that frequency hopping reduces co-channel interference. Rather, the Gitlits reference teaches that ensuring that adjoining cells transmit on different frequencies reduces co-channel interference (col. 1, lines 33-46).

Fourth, since, as explained above, the Gitlits reference clearly requires that a mobile

station switch frequencies even while maintaining communication with a single radio zone (frequency hopping) and the Examiner has alleged that it would have been obvious to modify the teachings of the D'Amico et al. references to require that a mobile station switch frequencies even while maintaining communication with a single radio zone, one of ordinary skill in the art would not have been motivated to modify the Examiner's alleged combination of the D'Amico et al. and Gitlits references to now remove the modification that is provided by the Gitlits reference in order to ensure "communication between the plurality of radio zones and the on-board mobile station is made using a single frequency within at least a single radio zone" as recited by, for example, independent claim 1.

The Gitlits reference specifically encourages the use of frequency hopping, which requires switching frequencies by the mobile terminal for any particular signal within each cell, the Gitlits reference actually teaches away from the claimed invention which recites continuously communicating with the on-board mobile terminal on the same frequency within each cell.

In order to frequency hop, each mobile terminal must switch frequencies along with the particular base station that is communicating with that mobile terminal. The Gitlits reference specifically explains that it is advantageous to perform frequency hopping because any one of the frequencies will only be able to adversely affect the particular signal being transmitted between the mobile terminal and the particular base station while that particular frequency is being used and will not adversely affect that particular signal when the particular signal has hopped over to a different frequency (col. 1, lines 53-65).

In stark contrast, the present invention is directed to reducing the burden that is placed on

the mobile terminals by not requiring them to switch frequencies at all within a single radio zone. Rather, the on-board mobile terminals in accordance with the present invention maintain continuous communication even while switching between a plurality of radio zones while only using a single frequency merely by switching time slots.

Therefore, one of ordinary skill in the art would not have been motivated to combine the teachings of the D'Amico et al., the Gitlits and the Barlett et al. references to arrive at the claimed invention.

Further, the Examiner admits that the D'Amico et al. '593 reference, the D'Amico et al. '100 reference and the Gitlits reference does not teach or suggest communication between the plurality of radio zones and the on-board mobile station using a single frequency within a single radio zone.

The Examiner then alleges that it would have been obvious to modify the D'Amico et al. '593 reference, the D'Amico et al. '100 reference and the Gitlits reference to use a single frequency in a single radio zone "so that the mobile station can handover without a change of frequency" and cites col. 4, lines 12-16 of the Barlett et el. reference in an attempt to support that allegation

However, the Examiner clearly mischaracterizes the teachings of the Barlett et al. reference.

The portion of the Barlett et al. reference that the Examiner cites states that "when a call terminates, a RCU on a time slot becomes free . . . In this situation, the controller 20 has the ability to move a call on to that time slot in order to make spare capacity available on a different

time slot. This is achieved by intra-cell handover in which the base station instructs the mobile to change its time slot with or without a change of frequency and simultaneously the base station and mobile change to the new time slot (and frequency if necessary)." (Emphasis added).

In other words, the Barlett et al. reference explains that it is irrelevant as to whether a frequency is changed or not. The Barlett et al. reference does not provide any motivation at all to maintain a frequency or not during the time slot change. Indeed, the Barlett et al. reference very carefully explains that the time slot change can be made "with or without" a change of frequency.

Therefore, the Examiner clearly mischaracterizes the Barlett et al. reference.

In summary, contrary to the Examiner's allegations, one of ordinary skill in the art would not have been motivated to combine the references to arrive at the claimed invention.

Lastly, contrary to the Examiner's allegations, none of the applied references teaches or suggests the features recited by independent claims 1, 4, 13, and 45-50 including: 1) an on-board mobile station; and 2) a plurality of radio zones which are consecutively arranged along a road.

Rather, the applied references merely disclose a conventional cellular network. None of the applied references teach or suggest that the mobile cellular telephones are on-board mobile cellular telephones or that the radio zones are consecutively arranged along a road.

Further, none of the applied references teaches or suggests a system and method that provides a plurality of N time slots in one period in each of the radio zones and sequentially switches the plurality of M communication frequencies from one to another at least one time within the one period (independent claim 1) or that provides a plurality of N time slots in one period in each of the radio zones and sequentially switches the plurality of M communication

frequencies from one to another at a timing of every N/M time slots (independent claims 4, 13, 40, and 45-50).

Therefore, the Examiner is respectfully requested to withdraw this rejection of claims 1-4, 8, 13-14, 20-21, 30-31, 34-35, and 42-50.

B. The D'Amico et al. '100 reference in view of the D'Amico et al. '593 reference in view of the Gitlits reference and in further view of the Barlett et al. reference and in even further view of the Janesch et al. reference

Regarding the rejection of claims 22-24, and 32-33, the Examiner alleges that the D'Amico et al. '593 reference would have been combined with D'Amico et al. '100 reference, that the Gitlits reference would have been combined with the combination of the D'Amico et al. '100 and D'Amico et al. '593 references and further that the Barlett et al. reference would have been combined with a combination of the D'Amico et al. '100, D'Amico et al. '593, and Gitlits references, and even yet further alleges that the Janesch et al. reference would have been combined with a combination of the D'Amico et al. '100, D'Amico et al. '593, Gitlits, and Barlett et al. references to form the claimed invention. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, the references are directed to completely different matters and problems.

As explained above, one of ordinary skill in the art who was concerned with the problem

of the substantial infrastructure investment and complexity that is required when each cell is required to measure and report signal strength to determine whether to hand off a call between cells as the two D'Amico et al. references are concerned with solving or who was concerned with the problem of a limited number of frequencies being available in a cluster of cells for performing frequency hopping as the Gitlits reference is concerned with solving, would not have referred to the Barlett et al. reference because the Barlett et al. reference is concerned with the completely different and unrelated problem of diversity combining of GSM cellular radio signals without incurring the cost of additional/duplicate circuitry.

In contrast to the D'Amico et al. references, the Gitlits reference and the Barlett et al. refrence, the Janesch et al. reference is directed to the completely different and unrelated problem of reducing the acquisition time of a carrier-recovery loop (col. 2, lines 22-23).

One of ordinary skill in the art who was concerned with the problem of the substantial infrastructure investment and complexity that is required when each cell is required to measure and report signal strength to determine whether to hand off a call between cells as the two D'Amico et al. references are concerned with solving, who was concerned with a limited number of frequencies being available in a cluster of cells for performing frequency hopping as the Gitlits reference is concerned with solving, or who was concerned with the problem of diversity combining of GSM cellular radio signals without incurring the cost of additional/duplicate circuitry as the Barlett et al. reference is concerned with solving would not have referred to the Janesch et al. reference because the Janesch et al. reference is directed to the completely different and unrelated problem of reducing the acquisition time of a carrier-recovery loop.

Thus, the references would not have been combined, absent hindsight.

Therefore, the Examiner is respectfully requested to withdraw this rejection of claims 22-24, and 32-33.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that claims 1-50, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: 6/28/04

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CERTIFICATION OF FACSIMILE TRANSMISSION

I hereby certify that I am filing this Amendment by facsimile with the United States Patent and Trademark Office to Examiner Nghi H. Ly, Group Art Unit 2686 at fax number (703) 872-9306 this 28th day of June, 2004.

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